"We Can Never Afford to Neglect the Question"

6

General John J. Pershing, in his *Final Report,* made specific reference to three weapons introduced in World War I and the impact each had on the conduct of the war. The three weapons Pershing listed were the tank, aircraft, and poison gas. Only one, gas, caused him to reflect on its use in any future war. He declared, "Whether or not gas will be employed in future wars is a matter of conjecture, but the effect is so deadly to the unprepared that we can never afford to neglect the question." Pershing, with the experience of the war behind him, pointed out that gas was a significant weapon, but not as a producer of battle deaths.[1]

The AEF suffered 34,249 immediate deaths on the battlefield. Of these, an estimated 200 were caused by gas.* The number of men wounded and evacuated to medical facilities numbered 224,089. Medical Department reports indicate 70,552 of these hospital patients suffered from gas wounds. Of these gas victims, 1,221 died in AEF hospital wards. When looking at the total figures, 27.3 percent of all AEF casualties, dead and wounded, were caused by gas. With respect to the burden gas casualties placed on medical facilities, not to mention the replacement system, a significant 31.4 percent of all AEF wounded were treated in hospitals for gas wounds (Table 2).[2]

Gas in World War I did not have to cause large numbers of casualties to be an effective and versatile weapon. Gas warfare placed additional strain on every aspect of combat. According to British Maj. Gen. Charles H. Foulkes, Commander of the Special Brigade, the "appearance of gas on the battlefield . . . changed the whole *character* of warfare." In World War I, gas was everywhere, in clothing, food, and water. It corroded human skin, internal organs, and even steel weapons. The smell of gas hung in the air, and the chemical environment became a reality of everyday life. Not only did men have to train constantly, but an entire logistical network had to be established for offensive and defensive gas equipment. A new branch of the U.S. Army came into existence, and new units, such as decontamination squads, mobile degassing units, and special gas troops, were created. These organizations, in turn, took manpower away from the combat arms, as

*This is a rough and perhaps low estimate. It was always difficult to determine the cause of death when shell-torn bodies were interred by Quartermaster troops.

combat arms officers became gas officers in divisions, regiments, and battalions. Also, the impact of gas on the Medical Department posed tremendous problems in the treatment of casualties. The number of gas wounded became so great that one field hospital out of four per division was dedicated to the treatment of gas victims.[3]

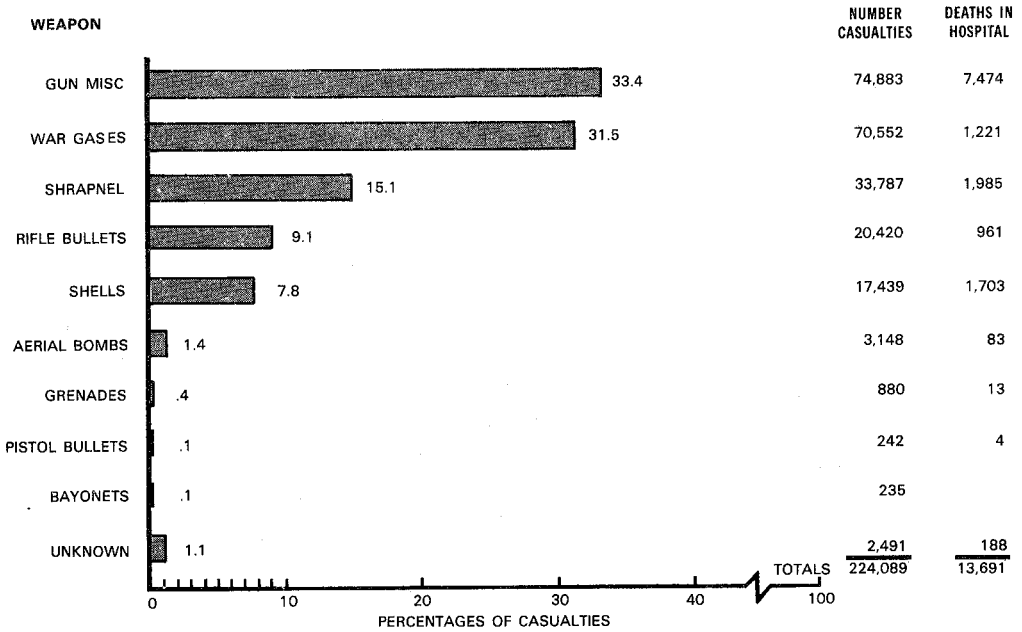

Table 2. Hospitalized casualties.

Despite the pervasive impact of chemical agents on the battlefield, commanders and staffs had difficulty adjusting their thinking and planning in such a way as to make effective use of these new weapons—weapons totally different from anything they had ever been trained to use. Not only did commanders and staffs have difficulty determining how they would employ the new weapon to their tactical advantage, but they also had to consider the effects of enemy gas on their own troops. By entering the conflict without preparation for chemical warfare, AEF commanders never fully comprehended the potential of gas on the battlefield.

The experience of the United States Army before and during World War I suggests several shortcomings in the military's preparation for, and later employment of, chemical warfare. Prior to American entry into the war, the War Department and General Staff virtually ignored the deployment of chemical weapons in Europe and did little or nothing to prepare the Army to fight and survive in a chemical environment. This pervasive neglect had an adverse impact on the capability of the AEF to fight effectively on a chemical battlefield. American troops entering front-line trenches were usually poorly trained and ill equipped to engage in gas warfare.

Proper defensive equipment is a minimal requirement for the successful engagement of forces in chemical warfare. The indispensable item for the World War I doughboy was his protective mask. Besides the filtration of all harmful agents, the mask had to fulfill a number of other requirements to be efficient. It had to be comfortable and allow for freedom of movement, full vision, easy breathing, communication, and durability. The American failure to develop a mask that could meet these requirements limited the combat effectiveness of the soldiers of the AEF. The decision to purchase the British SBR and, later, to manufacture an American version of it rather than to adopt and modify the more efficient and comfortable French *Tissot* was a serious error in judgment brought about by a lack of foresight and preparation.

The prewar failure to develop and experiment with new gases was also a serious shortcoming. If attention had been paid to the rapidly changing technology of chemical warfare, the United States, with its untapped industrial capacity, might have been able to overcome the German advantage. American technology might have produced the "king" of war gases, the persistent mustard agent, in a timely fashion. Instead, the Germans introduced this agent a year before the Allies.

After entry into the conflict, the United States geared up for production of war gases currently in use. Eventually mustard and other agents were shipped from the United States, but only in fifty-five-gallon containers. Production of chemical shells, based on French designs, was belatedly undertaken, and not a single American gas shell ever left the muzzle of an AEF artillery piece in combat. The unfortunate shortage of gas shells restricted the AEF's capability to retaliate in kind against the Germans; this, in turn, had a demoralizing effect on troops whose own positions had been liberally drenched with gas from German shells.

The AEF never found the key to effective education and training for the offensive and defensive aspects of chemical warfare. A significant advantage could have been obtained if both offensive and defensive training had been integrated into all aspects of instruction. Once a soldier understood the overall nature of gas warfare and acquired confidence in his equipment and gas officers, he more easily accepted and adjusted to chemicals in actual combat. Unfortunately, U.S. training in chemical warfare never reached the sophistication needed to achieve the desired results. Equipment shortages and the lack of trained instructors hampered the AEF's preparation to engage in chemical warfare. The Army suffered needless casualties as a consequence.

Good gas discipline was also essential to the conduct of chemical warfare. Very few soldiers reached the level of the 1st Infantry Division doughboy who, when asked by a staff officer if the gas alarm signified a drill, replied through his mask in muffled tones, "Put on your mask, put on your mask, you damn fool and don't ask questions." "Here," said the division commander who learned of the incident, "was the real thing in discipline." Discipline and training were required if men were to be expected to remain in a contaminated area. The soldier's determination to fight on would certainly

have been enhanced if he had had faith in his equipment and the knowledge that provisions had been made for the decontamination of himself and his gear.[4]

Had the U.S. Army's leaders, prior to America's entry into the war, prepared themselves intellectually by studying German gas doctrine or by reviewing observer reports, gas officers would not have had to overcome such strong resistance to the tactical employment of chemicals. Because the U.S. Army failed to develop gas warfare doctrine, the average AEF officer never really understood the potential value of chemicals. Nor could he put aside his preconceived, if perhaps erroneous notion, that chemicals were unusually inhumane weapons whose development should not be pursued. For America the real inhumanity of chemical warfare in World War I lay in the blindness of U.S. civilian and military leaders who, having ignored the real and present threat posed by gas, deployed the doughboys of the AEF to fight unprepared in a chemical environment. Ignorance, short-sightedness, and unpreparedness extracted a high toll at the front, a toll that the United States with its intellectual and technological resources should not have had to pay.

Notes

Introduction

1. Wayne Biddle, "Restocking the Chemical Arsenal," *New York Times Magazine*, 24 May 1981:36.
2. "Poisoning the Battlefield," *Time Magazine*, 10 March 1980:28.

Chapter 1

1. Amos A. Fries and Clarence J. West, *Chemical Warfare* (New York: McGraw-Hill, 1921), 1.
2. Ibid., 2—4; Alden H. Waitt, *Gas Warfare: The Chemical Weapon, Its Use and Protection Against It* (New York: Duell, Sloan, and Pearce, 1942), 7—11.
3. Waitt, *Gas Warfare*, 12—13.
4. Ian V. Hogg, *Gas*, Ballantine's Illustrated History of the Violent Century: Weapons Book no. 43, edited by Barrie Pitt (New York: Ballantine Books, 1975), 10—11; *Army and Navy Journal*, 8 May 1915:1141.
5. Barbara W. Tuchman, *The Guns of August* (New York: MacMillan, 1962), 119.
6. Rudolf Hanslian, *The German Gas Attack at Ypres on April 22, 1915* (Berlin: Verlag Gasschutz and Luftschutz, 1934), 6, translated by the Military Intelligence Division, U.S. Army War College; Charles H. Foulkes, *"Gas!" The Story of the Special Brigade* (Edinburgh: William Blackwood, 1936), 24; Ulrich Müller-Kiel, *Die Chemische Waffe im Weltkrieg und jetzt* [The chemical weapon during the war and now] (Berlin: Verlag Chemie, 1932), 16, translated by the Military Intelligence Division, U.S. Army War College; H. C. Peterson, *Propaganda for War* (Norman: University of Oklahoma Press, 1939), 63; Hogg, *Gas*, 19.
7. Foulkes, *"Gas!"*, 25; Victor Lefebure, *The Riddle of the Rhine: Chemical Strategy in Peace and War* (New York: E. P. Dutton & Co., 1923), 40; Hogg, *Gas*, 20—23; Curt Wachtel, *Chemical Warfare* (Brooklyn, NY: Chemical Publishing Co., 1941), 66.
8. Hogg, *Gas*, 23.
9. Augustin Mitchell Prentiss, *Chemicals in War: A Treatise on Chemical Warfare* (New York: McGraw-Hill Book Co., 1937), 435—36.
10. Hanslian, *Ypres*, 6—7; Hogg, *Gas*, 24; Wachtel, *Chemical Warfare*, 64.
11. Hanslian, *Ypres*, 10—12.

12. The description of the first gas attack is taken from the following sources: Hanslian, *Ypres*; Owen Spencer Watkins, unidentified article in *The Methodist Recorder* (Great Britain) quoted in *The Literary Digest*, 4 September 1915:483—86; and Basil Henry Liddell Hart, *The Real War, 1914-1918* (Boston: Little, Brown and Co., 1930), 175—85.

13. Foulkes, *"Gas!"*, 19—20.

14. The description of the British gas attack at Loos is taken from Ibid., 66—84; and Hart, *The Real War*, 186—98.

15. Foulkes, *"Gas!"*, 84.

Chapter 2

1. Müller-Kiel, *Chemische Waffe*, 49.

2. Hogg, *Gas*, 11—14.

3. Rudolf Hanslian, *Der Chemische Krieg* [The chemical war] (Berlin: E.S. Mittler & Sohn, 1927), 64, translated by the U.S. Army War College; Foulkes, *"Gas!"*, 263—64.

4. Hanslian, *Chemische Krieg*, 4.

5. Great Britain, Army, *Report on the Activities of the Special Brigade*, with chart on "Expansion of the Special Brigade," 19 December 1918, in possession of the author; France, Armée, Armées du Nord et du Nordest, *Instruction relative a l'Organization et a emploi des Unités spéciales, dites, Unités Z* [Instruction relative to the organization and use of special units, called Units Z], 23 January 1918, partial translation by Dr. Robert M. Epstein, Combat Studies Institute, U.S. Army Command and General Staff College, 1982; Hanslian, *Chemische Krieg*, 4. There were thirteen Russian field armies at the time that country left the war.

6. Foulkes, *"Gas!"*, 242—43.

7. Samuel James Manson Auld, "Chemical Warfare," *Chemical Warfare*, 15 March 1922:12—24, reprint of a lecture published in the *Royal Engineers Journal* (Great Britain) of February 1922; Foulkes, *"Gas!"*, 293.

8. Hanslian, *Chemische Krieg*, 4—5; Foulkes, *"Gas!"*, 94—95, 305.

9. Hanslian, *Chemische Krieg*, 48—49.

10. Prentiss, *Chemicals in War*, 440—45.

11. Ibid.

12. Foulkes, *"Gas!"*, 167, 169; Lefebure, *Riddle*, 62.

13. Hanslian, *Chemische Krieg*, 107.

14. Hogg, *Gas*, 48—49; Pascal Lucas, *The Evolution of Tactical Ideas in France and Germany during the War of 1914-1918* (Paris: Berger-Levrault, 1923), 34, translated by P. V. Kieffer, U.S. Army, in 1925.

15. Foulkes, *"Gas!"*, 145, 238 n. 145, 191; Donald Wilson, former Major, Special Brigade, Royal Engineers, interview with author, Fort McClellan, AL, 28 October 1981.

16. Foulkes, *"Gas!"*, 197—98.

17. Hanslian, *Chemische Krieg*, 45.

18. Prentiss, *Chemicals*, 458.

19. Hanslian, *Chemische Krieg*, 61.

20. Hogg, *Gas*, 119—20.
21. Hanslian, *Chemische Krieg*, 58.
22. Ibid.
23. Ibid., 63, 67—68; Fries and West, *Chemical Warfare*, 176.
24. Lucas, *Tactical Ideas*, 127.
25. Ibid., 22; Fries and West, *Chemical Warfare*, 205—6.
26. Robert Graves, *Goodbye to All That* (Garden City, NY: Doubleday Anchor Books, 1957, c1929), 95; Prentiss, *Chemicals*, 536.
27. Graves, *Goodbye*, 198.
28. Fries and West, *Chemical Warfare*, 197—98.
29. Prentiss, *Chemicals*, 539.
30. Fries and West, *Chemical Warfare*, 202.
31. Foulkes, *"Gas!"*, 312—13; U.S. War Department, *Gas Warfare*, pt. 1, *German Methods of Offense*, Document no. 705 (Washington, DC: U.S. Army War College/U.S. Government Printing Office, 1918), 19, hereafter cited as War Department, *Gas Warfare*, etc.; Prentiss, *Chemicals*, 540.

Chapter 3

1. Frederick Brown, *Chemical Warfare, A Study in Restraints* (Princeton, NJ: Princeton University Press, 1968), 15—17. I confirmed Brown's analysis of the propaganda war by examining prewar issues of the *Army-Navy Journal*, *The Literary Digest*, and the *New York Times*. I also looked at Harold D. Lasswell, *Propaganda in the World War* (New York: Peter Smith, 1938), and Peterson, *Propaganda for War*. Frederick Palmer, an astute wartime observer, gives an excellent overview of the effect Allied propaganda had on Americans in *Newton D. Baker, America at War*, 2 vols. (New York: Dodd, Mead, 1931), 1:36—39. See also Benedict Crowell, *America's Munitions, 1917-1918* (Washington, DC: U.S. Government Printing Office, 1919), 410.
2. Brown, *Chemical Warfare*, 40—41. Brown cites Chief of Staff Peyton C. March's comments that the use of gas "reduces civilization to savagery." From memoirs of World War I officers, especially those who served in the Chemical Warfare Service, it is apparent that this belief was widespread.
3. William A. Ganoe, *The History of the United States Army*, rev. ed. (Ashton, MD: Eric Lundberg, 1964), 452; Brown, *Chemical Warfare*, 21n.
4. U.S. Senate, Committee on Military Affairs, *Preparedness for National Defense*, 64th Cong., 1st sess. (Washington, DC: U.S. Government Printing Office, 1916), 483; Wilder D. Bancroft, et al., *Medical Aspects of Gas Warfare*, The Medical Department of the United States Army in the World War, vol. 14 (Washington, DC: U.S. Government Printing Office, 1926), 27.
5. Bancroft, et al., *Medical Aspects*, 27.
6. Ibid. In *Chemical Warfare*, Brown cites two reports, but these were filed after the U.S. declaration of war.
7. U.S. War Department, *Annual Report, 1917*, vol. 1, *The Secretary of War, et al.* (Washington, DC: U.S. Government Printing Office, 1918), 42.
8. Bancroft, et al., *Medical Aspects*, 27.

9. Fries and West, *Chemical Warfare*, 32.

10. Bancroft, et al., *Medical Aspects*, 28.

11. Crowell, *America's Munitions*, 413; G. A. Burrell, "The First Twenty Thousand," *Journal of Industrial Engineering*, 2 (1919), 93, quoted in Fries and West, *Chemical Warfare*, 43.

12. Bancroft, et al., *Medical Aspects*, 28.

13. Ibid.

14. Ibid., 30—31.

15. Ibid.; Fries and West, *Chemical Warfare*, 34.

16. Chief, Chemical Warfare Service, to Chief of Staff, A. E. F., 16 October 1918, Subj: Gas Training in [the] United States, reprinted in U.S. Army, Chemical Warfare Service, Defense Division, "Report on the Operations of the Defense Division, Chemical Warfare Service," Submitted to the Chief of Chemical Warfare Service in accordance with S. O. 31, December 1918, DTIC AD-498438, hereafter cited as "Report . . . Defense Division."

17. Edgar Dow Gilman, "Chemical Warfare. Lectures Delivered to the Reserve Officer Training Corps, University of Cincinnati: Gas Projector Attacks," *Chemical Warfare* 8 (15 July 1922):14; Robert Lee Bullard, *Personalities and Reminiscences of the War* (Garden City, NY: Doubleday, Page & Co., 1925), 193.

18. Samuel James Manson Auld, "A General Record of the American Chemical Warfare Service and the Relations Therewith of the British Gas Mission," 5 sect., 2:4, in the author's possession.

19. Ibid., 2:3.

20. Ibid., 1:3—5; Chief, Chemical Warfare Service, A. E. F., to all gas officers, 28 September 1918, Subj: Gas Defense Training, 35th Division Gas Officer File, Record Group 120, National Archives, Washington, DC.

21. Fries and West, *Chemical Warfare*, 66; Division Gas Officer, 29th Division, to Deputy Chief, Chemical Warfare Service, 13 January 1918, uncataloged Division Gas Officer Reports, U.S. Army Military History Institute, Carlisle Barracks, PA, hereafter cited as MHI; Baron Munchausen [pseud], "History of the 318th Field Hospital," World War I project, MHI.

22. Gilman, "Lectures," 16; Memorandum no. 65, HQ, 80th Division, Camp Lee, VA, 14 May 1918, uncataloged Division Gas Officer Reports, MHI.

23. General Order no. 108, 15 August 1917, cited in U.S. Army, A. E. F., 1917-1919, "History of the Chemical Warfare Service, American Expeditionary Forces, First Gas Regiment," 14 pts. in 1 vol. (Bound typescript; Fort Leavenworth, KS: General Service School, n.d.), pt. 1, hereafter cited as A. E. F., "History . . . lst Gas Regiment"; Ibid., 1:1, 4; Fries and West, *Chemical Warfare*, 42—44.

24. Crowell, *America's Munitions*, 418—28; Lt. Col. Amos A. Fries to Director of the Chemical Warfare Service, 19 March 1919, Subj: "History of Chemical Warfare Service in France," uncataloged manuscript, MHI, 5, 24, 27—29.

25. Crowell, *America's Munitions*, 397; Fries and West, *Chemical Warfare*, 53.

26. E. Alexander Powell, *The Army Behind the Army* (New York: Charles Scribner's Sons, 1919), 125; Crowell, *America's Munitions*, 397—408.

27. Prentiss, *Chemicals*, 81—82.

28. Fries and West, *Chemical Warfare*, 60—70.

Chapter 4

1. U.S. Department of the Army, Historical Division, *United States Army in the World War, 1917-1919*, vol. 16, *General Orders, G. H. Q., A. E. F.*, G. O. no. 8, 5 July 1917, "Organization of Headquarters, American Expeditionary Forces," Table 4, "Technical and Administration Services (Gas Service)" (Washington, DC: U.S. Government Printing Office, 1948), 23, hereafter cited as *General Orders, A. E. F.*
2. Fries, "History," 2.
3. Ibid.
4. Ibid., 3; *General Orders, A. E. F.*, G. O. no. 31, 3 September 1917, 67—68.
5. *General Orders, A. E. F.*, G. O. no. 79, 27 May 1918, 327—29.
6. Ibid., G. O. no. 107, 2 July 1918, 370.
7. Fries, "History," 5.
8. War Department, *Gas Warfare*, pt. 2, *Methods of Defense Against Gas Attacks*, 14—18; Fries, "History," 11, 24, 27; Fries and West, *Chemical Warfare*, 50—51.
9. Fries, "History," 28—29.
10. Ibid., 29.
11. Ibid., 8—9; Crowell, *America's Munitions*, 406—9; Powell, *The Army*, 125; Prentiss, *Chemicals*, 481.
12. Prentiss, *Chemicals*, 462.
13. *General Orders, A. E. F.*, G. O. no. 53, 3 November 1917, 100.
14. U.S. War Department, *Memorandum on Gas Poisoning in Warfare with Notes on Its Pathology and Treatment* (Washington, DC: U.S. Government Printing Office, 1917); Fries, "History," 9—10.
15. U.S. Army, Chemical Warfare Service, Medical Director, "History of Chemical Warfare Service, American Expeditionary Forces, Medical Director" (N.p., 1918), 1, DTIC AD-494989, hereafter cited as "History . . . Medical Director"; Bancroft, et al., *Medical Aspects*, 59.
16. "History . . . Medical Director," 2—3.
17. Ibid.
18. E. W. Spencer, "The History of Gas Attacks upon the American Expeditionary Forces During the World War," 4 pts (Bound typescript; Edgewood Arsenal, MD: Chemical Warfare Service, U.S. War Department, 15 February 1928), 3:403—4; J. W. Grissinger, *Medical Field Service in France* (Washington, DC: The Association of Military Surgeons, 1928), 28—29, reprinted from *The Military Surgeon* 61—63 (1927—1928).
19. Grissinger, *Medical Field Service*, 41.
20. *General Orders, A. E. F.*, G. O. no. 144, 29 August 1918, 429—32; Bancroft, et al., *Medical Aspects*, 60, 838.
21. Bancroft, et al., *Medical Aspects*, 45, 49.
22. Fries and West, *Chemical Warfare*, 86; Gilman, "Lectures," 14.
23. Norman A. Dunham, "The War As I Saw It," 3 vols., manuscript, World War I project, MHI, 1:166, 168; Gilman, "Lectures," 14.
24. U.S. Army, Chemical Warfare Service, European Division, "Training Activities of the Chemical Warfare Service" (N.p., 1919). Unless otherwise indicated all of the information pertaining to defensive gas training is from this unnumbered publication.

25. "History . . . 1st Gas Regiment," 1:5—7, 2:9—10.

26. Auld, "General Record," 2:5; U.S. Army, A. E. F., 1917-1919, 1st Army, *Provisional Instructions for Artillery Officers on the Use of Gas Shell* (N.p.: Base Printing Plant, 29th Engineers, 1918); U.S. Army, A.E.F., 1917-1919, *Gas Manual*, pt. 2, *Use of Gas by the Artillery* (France, March 1919), hereafter cited as *Gas Manual*, pt. 2; U.S. Army, Chemical Warfare Service, "History of the Chemical Warfare Service, American Expeditionary Forces" (N.p., 1918), 43, DTIC AD-495051.

Chapter 5

1. Bullard, *Personalities*, 136.

2. Rexmond C. Cochrane, *The 1st Division at Ansauville, January-April 1918*, U.S. Army Chemical Corps Historical Studies: Gas Warfare in World War I, Study no. 9 (Army Chemical Center, MD: Historical Officer, U.S. Army Chemical Corps, 1958), 12—13.

3. Ibid., 5; U.S. Army, 16th Infantry Regiment, "The Story of the 16th Infantry in France," typescript, World War I project, MHI, 8.

4. War Department, *Gas Warfare*, pt. 3, *Methods of Training in Defensive Measures*, 26—28.

5. Amos A. Fries, *-Gas in Defense-*, in *-Gas in Attack- and -Gas in Defense-* (Fort Leavenworth, KS: The General Service Schools Press, n.d.), 17—18, reprinted from the *National Service Magazine*, June-July 1919; "Report . . . Defense Division," 12.

6. "Report . . . Defense Division," 14.

7. Bullard *Personalities*, 159; "Report . . . Defense Division," 14.

8. U.S. Army, A. E. F., Office of the Chief of Gas Service, "Semi-monthly Report to Director of Gas Service, U.S., on Activities and Needs of the Gas Service, A. E. F.," 15 May 1918, 2, DTIC AD-498800.

9. "Report . . . Defense Division," 14.

10. Dorothy Kneeland Clark, *Effectiveness of Chemical Weapons in World War I*, Staff paper ORO-SP-88 (Bethesda, MD: Tactics Division, Operations Research Office, Johns Hopkins University, 1959), 75; U.S. Army, A. E. F., 1917-1919, *Defensive Measures Against Gas Attack*, No. 253 revised (France, November 1917), 8, hereafter cited as *Defensive Measures.*

11. Moses King, "Diary of Moses King, Company I, 305th Infantry, U.S.N.A.," n.d., World War I project, MHI; Chief, CWS, to all gas officers, 28 September 1918, RG 120, National Archives.

12. Harry L. Gilchrist, *A Comparative Study of World War Casualties From Gas and Other Weapons* (Edgewood Arsenal, MD: Chemical Warfare School, 1928), 21; "Report . . . Defense Division," 16; Clarence M. Wood, former medic, 140th Ambulance Company, 35th Division, letter to the author, 19 October 1981; Prentiss, *Chemicals in War*, 565.

13. Prentiss, *Chemicals in War*, 564—65; "Report . . . Defense Division"; Fries and West, *Chemical Warfare*, 272—74; Waitt, *Gas Warfare*, 195.

14. *General Orders, A. E. F.*, G. O. no. 144, 29 August 1918, 432; Fries, *-Gas in Defense-*, 15—16.

15. Foulkes, *"Gas!"*, 101—2.

16. Fries *-Gas in Defense-*, 14; War Department, *Gas Warfare*, 2:14.

17. Fries *-Gas in Defense-*, 11; War Department, *Gas Warfare*, 2:31.

18. Rexmond C. Cochrane, *The 42nd Division Before Landres-et-St-Georges, October 1918*, U.S. Army Chemical Corps Historical Studies: Gas Warfare in World War I, Study no. 17 (Army Chemical Center, MD: Historical Office, U.S. Army Chemical Corps, 1960), 13—15.

19. Fries, *-Gas in Defense-*, 9—10.

20. *General Orders, A. E. F.*, G. O. no. 107, 2 July 1918, 370; Fries and West, *Chemical Warfare*, 89—91; Charles R. Shrader, *Amicicide: The Problem of Friendly Fire in Modern War*, Research Survey no. 1 (Fort Leavenworth, KS: Combat Studies Institute, U.S. Army Command and General Staff College, 1982), xii, 2.

21. U.S. Army, 26th Division, Gas Officer, "Report of Growth, Organization and Accomplishments of the Division Gas Officer, With Suggested Duties of Officers," 25 November 1918, Record Group 120, National Archives, Washington, DC.

22. Ibid.

23. Harold Reigelman, "A Chemical Officer at the Front," *Chemical Warfare Bulletin* 23 (April 1937):42.

24. Ibid., 54.

25. Spencer, "Gas Attacks," pt. 1, "First Division," 8—13.

26. Reigelman, "At the Front," 51.

27. Laurence Stallings, *The Doughboys* (New York: Harper and Row, 1963), 100—1.

28. Bullard, *Personalities*, 193.

29. Stallings, *The Doughboys*, 377; quotation in D. Clayton James, *The Years of MacArthur*, vol. 1, *1880—1941* (Boston: Houghton Mifflin Co., 1970), 197.

30. Andrew Kachik, "Diary" [of service with the 314th Infantry, 79th Infantry Division], 29 September 1918, World War I project, MHI; George F. Unmacht, "The Effects of Chemical Agents on Quartermaster Supplies," *The Quartermaster Review* 14 (November-December 1934):54; Fries, *-Gas in Defense-*, 16; *Defensive Measures*, 12.

31. Division Gas Officer, 32d Division to Commanding General 32d Division, "Monthly Report," n.d., Record Group 120, National Archives, Washington, DC; Spencer, "Gas Attacks," pt. 1, "1st Division," 3; Regimental Gas Officer, 18th Infantry, to Commanding Officer," 5 May 1918, quoted in Rexmond C. Cochrane, *The 1st Division at Cantigny, May 1918*, U.S. Army Chemical Corps Historical Studies: Gas Warfare in World War I, Study no. 11 (Army Chemical Center, MD: Historical Office, U.S. Army Chemical Corps, 1958), 19—20; "Report . . . Defense Division," 10, 14; *General Orders, A. E. F.*, G. O. no. 78, 25 May 1918.

32. Clark, *Effectiveness*, 75; Division Gas Officer, 29th Division, to Chief Gas Officer, 1st Army, "Report on Recent Operations," 20 November 1918, Record Group 120, National Archives, Washington, DC; Willard Newton, "Over There for Uncle Sam: A Daily Diary of World War One," n. d., 95, World War I project, MHI; Division Gas Officer, 29th Division to Chief Gas Officer, 1st Army, A. E. F, "Report on Recent Operations," 20 October 1918, uncataloged Division Gas Officer Files, MHI.

33. Clark, *Effectiveness*, 73—74.

34. Karl Edwin Harriman, *The Cannoneers Have Hairy Ears* (New York: J. H. Sear, 1927), 50, 176; Waitt, *Gas Warfare*, 195.

35. Cochrane, *The 42d Division*, 9.

36. "History . . . Medical Director," 17; Bancroft, et al., *Medical Aspects*, 65.

37. "History . . . Medical Director," 17, Bancroft, et al., *Medical Aspects*, 65.

38. Wood letter.

39. Grissinger, *Medical Field Service*, 71.

40. Medical Director, Gas Service, to Chief of Gas Service, A. E. F, 1 July 1918, Subj: Report of Second Serious Gas Attack in 2d Division, reprinted in Bancroft, et al., *Medical Aspects*, 71—73.

41. *Gas Manual*, 2:12—13.

42. Ibid., 12.

43. Conrad H. Lanza, "Counterbattery," *Chemical Warfare Bulletin* 23 (July 1937):89—91; Lucas, *Tactical Ideas*, 57.

44. Bullard, *Personalities*, 193—94; General Orders, A. E. F., G. O. no. 107, 2 July 1918, 370.

45. Lanza, "Counterbattery," 92.

46. Rexmond C. Cochrane, *The Use of Gas in the Meuse-Argonne Campaign, September-November 1918*, U.S. Army Chemical Corps Historical Studies: Gas Warfare in World War I, Study no. 10 (Army Chemical Center, MD: Historical Office, U.S. Army Chemical Corps, 1958), 89; "History . . . 1st Gas Regiment, pt. 3., sect. 6, 1—35; Fries and West, *Chemical Warfare*, 90.

47. "History . . . 1st Gas Regiment," 1:1.

48. Ibid., 4:1, 3; pt. 3, sect. 4:8.

49. Ibid., 4:1—2.

50. Ibid., 4:3.

51. James Thayer Addison, *The Story of the First Gas Regiment* (Boston: Houghton Mifflin Co., 1919), 149—50; "History . . . 1st Gas Regiment," pt. 3, sect. 4:8.

52. "History . . . 1st Gas Regiment," pt. 3, sect. 5:14.

53. Addison, *First Gas Regiment*, 150.

Chapter 6

1. John J. Pershing, *Final Report of General John J. Pershing, Commander-in-Chief American Expeditionary Forces* (Washington, DC: U.S. Government Printing Office, 1920), 77.

2. In researching gas casualty statistics, I found minor discrepancies and a variety of reporting methods. The studies I examined included Albert G. Love, *Statistics*, pt. 2, *Medical and Casualty Statistics*, The Medical Department of the United States Army in the World War, vol. 15 (Washington, DC: U.S. Government Printing Office, 1925); Albert G. Love, *War Casualties*, Army Medical Bulletin no. 24 (Carlisle Barracks, PA: Medical Field Service School, 1931); and Harry L. Gilchrist, *A Comparative Study of World War Casualties From Gas and Other Weapons* (Edgewood Arsenal, MD: Chemical Warfare School, 1928). I found that the latter had the clearest format and figures that were substantiated by the other studies. The figures do not include casualties in the Marine Brigade of the 2nd Infantry Division.

3. Foulkes, *"Gas!"*, 345.

4. Bullard, *Personalities*, 161.

Bibliography

Primary Sources

Unpublished

Auld, Samuel James Manson. "A General Record of the American Chemical Warfare Service and the Relations Therewith of the British Gas Mission." 5 sect. In the author's possession.

Chief, Chemical Warfare Service, A. E. F., to all gas officers, 28 September 1918, Subj: Gas Defense Training. 35th Division Gas Officer Files, Record Group 120, National Archives, Washington, DC.

Chief, Chemical Warfare Service, to Chief of Staff, A. E. F., 16 October 1918, Subj: Gas Training in [the] United States. Reprinted in U.S. Army, Chemical Warfare Service, Defense Division, "Report on the Operations of the Defense Division, Chemical Warfare Service." Submitted to the Chief of Chemical Warfare Service in accordance with S. O. 31, December 1918. DTIC AD-498438.

Division Gas Officer, 29th Division, to Chief Gas Officer, 1st Army. "Report on Recent Operations." 20 November 1918. Record Group 120, National Archives, Washington, DC.

Division Gas Officer, 29th Division, to Chief Gas Officer, 1st Army, A. E. F. "Report on Recent Operations." 20 October 1918. Uncataloged Division Gas Officer Files, U.S. Army Military History Institute, Carlisle Barracks, PA.

Division Gas Officer, 29th Division, to Deputy Chief, Chemical Warfare Service, 13 January 1918. Uncataloged Division Gas Officer Reports, U.S. Army Military History Institute, Carlisle Barracks, PA.

Division Gas Officer, 32d Division, to Commanding General, 32d Division. "Monthly Report." N.d. Record Group 120, National Archives, Washington, DC.

Dunham, Norman A. "The War as I Saw It." 3 vols. Manuscript. World War I project, U.S. Army Military History Institute, Carlisle Barracks, PA.

Fries, Amos A., Lt. Col., to Director of the Chemical Warfare Service, 19 March 1919, Subj: "History of Chemical Warfare Service in France." Uncataloged manuscript. U.S. Army Military History Institute, Carlisle Barracks, PA.

Kachik, Andrew. "Diary" [of service with the 314th Regiment, 79th Infantry Division]. World War I project, U.S. Military History Institute, Carlisle Barracks, PA.

King, Moses. "Diary of Moses King, Company I, 305th Infantry, U.S.N.A." N.d. World War I project, U.S. Army Military History Institute, Carlisle Barracks, PA.

Memorandum no. 65, HQ, 80th Division, Camp Lee, VA, 14 May 1918. Uncataloged Division Gas Officer Reports, U.S. Army Military History Institute, Carlisle Barracks, PA.

Munchausen, Baron [pseud.]. "History of the 318th Field Hospital." World War I project, U.S. Army Military History Institute, Carlisle Barracks, PA.

Newton, Willard. "Over There for Uncle Sam: A Daily Diary of World War One." World War I project, U.S. Army Military History Institute, Carlisle Barracks, PA.

Spencer, E. W. "The History of Gas Attacks upon the American Expeditionary Forces During the World War." 4 pts. Bound typescript. Edgewood Arsenal, MD: Chemical Warfare Service, U.S. War Department, 15 February 1928.

U.S. Army. A. E. F., 1917—1919. 1st Gas Regiment. "History of the Chemical Warfare Service, American Expeditionary Forces, 1st Gas Regiment." 14 pts. in 1 vol. Bound typescript. Fort Leavenworth, KS: General Service School, n.d.

_____. Office of the Chief of Gas Service. "Semi-monthly Report to Director of Gas Service, U.S., on Activities and Needs of the Gas Service, A. E. F." 15 May 1918. DTIC AD-498800.

U.S. Army. Chemical Warfare Service. "History of the Chemical Warfare Service, American Expeditionary Forces." N.p., 1918.

_____. Defense Division. "Report on the Operations of the Defense Division, Chemical Warfare Service." Submitted to the Chief of Chemical Warfare Service in accordance with S. O. 31, December 1918. DTIC AD-498438.

_____. European Division. "Training Activities of the Chemical Warfare Service." N.p., 1919.

_____. Medical Director. "History of Chemical Warfare Service, American Expeditionary Forces, Medical Director." N.p., 1918. DTIC AD-494989.

U.S. Army. 26th Division. Gas Officer. "Report of Growth, Organization and Accomplishments of the Division Gas Office, with Suggested Duties of Officers." 25 November 1918. Record Group 120, National Archives, Washington, DC.

U.S. Army. 16th Infantry Regiment. "The Story of the 16th Infantry in France." Typescript. World War I project, U.S. Army Military History Institute, Carlisle Barracks, PA.

Wilson, Donald, former Major, Special Brigade, Royal Engineers. Interview with author. Fort McClellan, AL, 28 October 1981.

Wood, Clarence M., former medic, 140th Ambulance Co., 35th Division. Letter to author. 19 October 1981. In the author's possession.

Published

Addison, James Thayer. *The Story of the First Gas Regiment.* Boston: Houghton Mifflin Co., 1919.

Army and Navy Journal, 8 May 1915:1141.

Auld, Samuel James Manson. "Chemical Warfare." *Chemical Warfare,* 15 March 1922:12—24. Reprint of a lecture published in the *Royal Engineers Journal* (Great Britain) of February 1922.

Bullard, Robert Lee. *Personalities and Reminiscences of the War.* Garden City, NY: Doubleday, Page & Co., 1925.

Burrell, G. A. "The First Twenty Thousand." *Journal of Industrial Engineering* 2 (1919). Quotation in Amos A. Fries and Clarence J. West, *Chemical Warfare.* New York: McGraw-Hill, 1921.

Crowell, Benedict. *America's Munitions, 1917—1918.* Washington, DC: U.S. Government Printing Office, 1919.

Foulkes, Charles H. *"Gas!" The Story of the Special Brigade.* Edinburgh: William Blackwood, 1936.

France. Armée. Armées du Nord et du Nordest. *Instruction relative a l'Organization et a emploi des Unités spéciales, dites, Unités Z* [Instruction relative to the organization and use of special units, called Units Z]. 23 January 1918. Partial translation by Dr. Robert M. Epstein, Combat Studies Institute, U.S. Army Command and General Staff College, 1982.

Fries, Amos A. *-Gas in Defense-.* In *-Gas in Attack- and -Gas in Defense-.* Fort Leavenworth, KS?: The General Service Schools, n.d.? Reprinted from the *National Service Magazine,* June-July 1919.

Fries, Amos A., and Clarence J. West. *Chemical Warfare.* New York: McGraw-Hill, 1921.

Gilman, Edgar Dow. "Chemical Warfare. Lectures Delivered to the Reserve Officer Training Corps, University of Cincinnati: Gas Projector Attacks." *Chemical Warfare* 8 (15 July 1922):11—16.

Graves, Robert. *Goodbye to All That.* Garden City, NY: Doubleday Anchor Books, 1957, c1929.

Great Britain. Army. *Report on the Activities of the Special Brigade.* With chart on "Expansion of the Special Brigade." 19 December 1918. In the author's possession.

Grissinger, J. W. *Medical Field Service in France.* Washington, DC: The Association of Military Surgeons, 1928.

Harriman, Karl Edwin. *The Cannoneers Have Hairy Ears.* New York: J. H. Sear, 1927.

Lucas, Pascal. *The Evolution of Tactical Ideas in France and Germany During the War of 1914—1918.* Paris: Berger-Levrault, 1923. Translated by P. V. Kieffer, U.S. Army, in 1925.

Pershing, John J. *Final Report of General John J. Pershing, Commander-in-Chief American Expeditionary Forces.* Washington, DC: U.S. Government Printing Office, 1920.

Reigelman, Harold. "A Chemical Officer at the Front." *Chemical Warfare Bulletin* 23 (April, July, and October 1937):42—55, 106—16, 151—63. Reprinted from *War Notes of a Casual,* publication information unknown.

U.S. Army. A. E. F., 1917—1919. *Defensive Measures Against Gas Attack.* No. 253, revised. France, November 1917.

_____. Gas Manual. Pt. 2. *Use of Gas by the Artillery.* France, March 1919.

_____. 1st Army. *Provisional Instructions for Artillery Officers on the Use of Gas Shell.* N.p.: Base Printing Plant, 29th Engineers, 1918.

U.S. Department of the Army. Historical Division. *United States Army in the World War, 1917—1919.* Vol. 16. *General Orders, G. H. Q., A. E. F.* Washington, DC: U.S. Government Printing Office, 1948.

U.S. Senate. Committee on Military Affairs. *Preparedness for National Defense.* 64th Cong., 1st sess. Washington, DC: U.S. Government Printing Office, 1916.

U.S. War Department. *Annual Report, 1917.* Vol. 1. *The Secretary of War, et al.* Washington, DC: U.S. Government Printing Office, 1918.

_____. *Gas Warfare.* Pt. 1. *German Methods of Offense.* Pt. 2. *Methods of Defense Against Gas Attacks.* Pt. 3. *Methods of Training in Defensive Measures.* Washington, DC: U.S. Army War College/U.S. Government Printing Office, 1918.

_____. *Memorandum on Gas Poisoning in Warfare with Notes on Its Pathology and Treatment.* Washington, DC: U.S. Government Printing Office, 1917.

Watkins, Owen Spencer. Unidentified article in *The Methodist Recorder* (Great Britain) quoted in *The Literary Digest,* 4 September 1915:483—86.

Other Works

Bancroft, Wilder D., et al. *Medical Aspects of Gas Warfare.* The Medical Department of the United States Army in the World War, vol. 14. Washington, DC: U.S. Government Printing Office, 1926.

Biddle, Wayne. "Restocking the Chemical Arsenal." *New York Times Magazine,* 24 May 1981.

Brown, Frederick. *Chemical Warfare, a Study in Restraints.* Princeton, NJ: Princeton University Press, 1968.

Clark, Dorothy Kneeland. *Effectiveness of Chemical Weapons in World War I.* Staff paper ORO-SP-88. Bethesda, MD: Tactics Division, Operations Research Office, Johns Hopkins University, 1959. DTIC AD-233081.

Cochrane, Rexmond C. *The 1st Division at Ansauville, January-April 1918.* U.S. Army Chemical Corps Historical Studies: Gas Warfare in World War I, Study no. 9. Army Chemical Center, MD: Historical Office, U.S. Army Chemical Corps, 1958.

———. *The 1st Division at Cantigny, May 1918.* U.S. Army Chemical Corps Historical Studies: Gas Warfare in World War I, Study no. 11. Army Chemical Center, MD: Historical Office, U.S. Army Chemical Corps, 1958.

———. *The 42nd Division Before Landres-et-St. Georges, October 1918.* U.S. Army Chemical Corps Historical Studies: Gas Warfare in World War I, Study no. 17. Army Chemical Center, MD: Historical Office, U.S. Army Chemical Corps, 1960.

———. *The Use of Gas in the Meuse-Argonne Campaign, September-November 1918.* U.S. Army Chemical Corps Historical Studies: Gas Warfare in World War I, Study no. 10. Army Chemical Center, MD: Historical Office, U.S. Army Chemical Corps, 1958.

Ganoe, William A. *The History of the United States Army.* Rev. ed. Ashton, MD: Eric Lundberg, 1964.

Gilchrist, Harry L., Col. *A Comparative Study of World War Casualties from Gas and Other Weapons.* Edgewood Arsenal, MD: Chemical Warfare School, 1928.

Hanslian, Rudolf. *Der Chemische Krieg* [The chemical war]. Berlin: E. S. Mittler & Sohn, 1927. Translated by the U.S. Army War College.

———. *The German Gas Attack at Ypres on April 22, 1915.* Berlin: Verlag Gasschutz and Luftschutz, 1934. Translated by the Military Intelligence Division, U.S. Army War College.

Hogg, Ian V. *Gas.* Ballantine's Illustrated History of the Violent Century: Weapons Book no. 43, edited by Barrie Pitt. New York: Ballantine Books, 1975.

James, D. Clayton. *The Years of MacArthur.* Vol. 1. *1880—1941.* Boston: Houghton Mifflin Co., 1970.

Lanza, Conrad H. "Counterbattery." *Chemical Warfare Bulletin* 23 (July 1937):87—94.

Lasswell, Harold D. *Propaganda in the World War.* New York: Peter Smith, 1938.

Lefebure, Victor. *The Riddle of the Rhine: Chemical Strategy in Peace and War.* New York: E. P. Dutton & Co., 1923.

Liddell Hart, Basil Henry. *The Real War, 1914—1918.* Boston: Little, Brown and Co., 1930.

Love, Albert G., Maj. *Statistics.* Pt. 2. *Medical and Casualty Statistics.* The Medical Department of the United States Army in the World War, vol. 15. Washington, DC: U.S. Government Printing Office, 1925.

_____. *War Casualties.* Army Medical Bulletin no. 24. Carlisle Barracks, PA: Medical Field Service School, 1931.

Müller-Kiel, Ulrich. *Die Chemische Waffe im Weltkrieg und Jetzt* [The chemical weapon in the World War and now]. Berlin: Verlag Chemie, 1932. Translated by the Military Intelligence Division, U.S. Army War College.

Palmer, Frederick. *Newton D. Baker, America at War.* 2 vols. New York: Dodd, Mead, 1931.

Peterson, H. C. *Propaganda for War.* Norman: University of Oklahoma Press, 1939.

"Poisoning the Battlefield." *Time Magazine,* 10 March 1980:28.

Powell, E. Alexander. *The Army Behind the Army.* New York: Charles Scribner's Sons, 1919.

Prentiss, Augustin Mitchell. *Chemicals in War: A Treatise on Chemical Warfare.* New York: McGraw-Hill Book Co., 1937.

Shrader, Charles R. *Amicicide: The Problem of Friendly Fire in Modern War.* Research Survey no. 1. Fort Leavenworth, KS: Combat Studies Institute, U.S. Army Command and General Staff College, 1982.

Stallings, Laurence. *The Doughboys.* New York: Harper and Row, 1963.

Tuchman, Barbara W. *The Guns of August.* New York: Macmillan, 1962.

Unmacht, George F. "The Effects of Chemical Agents on Quartermaster Supplies." *The Quartermaster Review* 14 (November-December 1934):53—55.

Wachtel, Curt. *Chemical Warfare.* Brooklyn, NY: Chemical Publishing Co., 1941.

Waitt, Alden H. *Gas Warfare: The Chemical Weapon, Its Use and Protection Against It.* New York: Duell, Sloan and Pearce, 1942.

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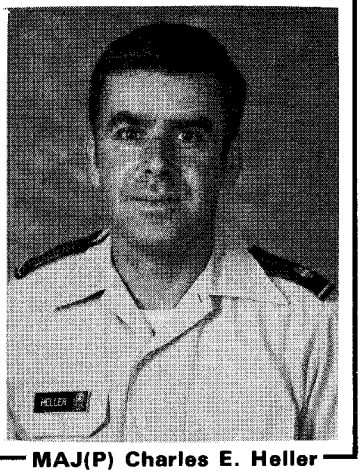

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The Combat Studies Institute was established on 18 June 1979 as a separate, department-level activity within the U.S. Army Command and General Staff College, Fort Leavenworth, Kansas, for the purpose of accomplishing the following missions:

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Synopsis of Leavenworth Paper 10

Although *Leavenworth Paper No. 10* is primarily concerned with the American response to gas warfare in World War I, it begins by examining the pertinent events leading up to the German gas attack at Ypres in April 1915 and surrounding the subsequent escalation of the chemical war to its peak in 1918.

The United States entered the war in April 1917, two years after the German Imperial Army's first successful gas attack against the Allies. Although the U.S. Army was aware of the increasing use of chemicals on European battlefields, it made no effort to prepare for gas warfare until two months before the American declaration of war. As a result, the Army began the war without a doctrine or adequate training program for chemical warfare and was dependent on the Allies for gas-related equipment. While steps were taken to correct these deficiencies, the first U.S. units to arrive in France were ill-prepared to use or defend against chemical weapons. Officers and NCOs of the newly created Gas Service labored feverishly to train and equip American doughboys before they reached the front, but the task was monumental and satisfactory results were not always achieved. Once in the trenches, the American Expeditionary Forces found gas warfare an inescapable fact of life. Even the better trained troops had difficulty coping with an agent that appeared everywhere—in clothing, food, and water; on equipment; and in the mud of trenches. When on the offensive, American officers were often reluctant to employ chemical agents for fear of inviting German retaliation. At war's end, the U.S. Army had yet to master the art of chemical warfare.